Appendix G2. Prediction of Vegetation on the Delta Wetlands Reservoir Islands

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Appendix G2. Prediction of Vegetation on the Delta Wetlands Reservoir Islands

The Delta Wetlands (DW) reservoir islands will be used for potential year-round diversion and storage of water for sale and/or release during periods of demand. DW may also use reservoir islands for water transfer or banking. Under the DW project alternatives, changes in vegetation types on the DW reservoir islands would result from the water storage and wetland management pattern, land disturbance attributable to levee improvements, and siphon and pump station siting. Under Alternatives 1 and 2, all vegetation impacts associated with operation of the DW reservoir islands would be offset with implementation of the habitat management plan (HMP) (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands").

METHODS USED TO PREDICT VEGETATION CHANGES

Alternatives 1, 2, and 3

Prediction of future vegetation conditions on the DW reservoir islands is difficult because periods of inundation and drawdown are not predictable between years, and the hydrologic pattern of project operations will not replicate any hydrologic pattern that occurs naturally in the Delta region. Therefore, vegetation changes cannot be predicted through comparison with the vegetation of an existing Delta habitat because no existing habitat is associated with a hydrologic pattern similar to that of any of the DW project alternatives.

The following types of information were used to predict new vegetation conditions to be created under the DW project alternatives:

- estimates of end-of-month storage volumes generated by the DeltaSOS model (see Appendix G4, "Simulated End-of-Month Water Storage on Reservoir Islands for the Delta Wetlands Project Alternatives");
- postproject elevation-area and elevation-storage relationships on reservoir islands (Jones & Stokes Associates [JSA] 1991);
- observations of vegetation response in a demonstration wetland operated by DW on Holland Tract that followed the hydrologic pattern and management plan for a previous DW proposed project; and
- information presented in Chapters 2, "Delta Wetlands Project Alternatives", and 3D, "Flood Control".

The 70-year hydrologic record for the Delta provides the best estimate of likely future Delta hydrologic conditions; the DeltaSOS simulations of end-of-month water storage volumes are therefore based on estimates of water that would be available for DW diversion and discharge under hydrologic conditions replicating those of the 70-year period of record for the Delta. Future conditions may not correspond with past conditions, however, and the availability of water for future storage therefore may not follow the estimated frequencies. Prediction of future conditions on any island is further complicated because DW may fill reservoir islands concurrently, sequentially, or in a sequence that changes each year to maximize the foraging quality for waterfowl during periods when the islands could be managed as shallow-water wetlands (see "Habitat Condition Class Definitions" below). DW may also use the reservoir islands for water banking or to divert, store, and discharge water being transferred through the Delta by other entities.

Reservoir Operation Assumptions

For purposes of predicting vegetation conditions, the following assumptions were used for each project alternative:

- As water becomes available, it would be diverted simultaneously and at an equal rate onto each island (this assumes the greatest adverse impact on reservoir island vegetation).

- DW will not bank or store water transferred through the Delta by other entities. (Because the frequency and magnitude of these operations are unknown, the impacts of these actions cannot be estimated in this document.)
- The growing season for vegetation is from April through October.
- A period of 60 consecutive days without inundation during the growing season is required for watergrass and other waterfowl food plants to mature.
- Five habitat condition classes may exist on the reservoir islands: full storage, partial storage, shallow storage, nonstorage, and shallow-water wetland.
- Water diverted under riparian or appropriative water rights would be used to create shallow-water wetlands during years when at least 60 consecutive days of nonstorage have preceded any day from September 15 to November 30. (At DW's discretion, however, shallow-water wetlands may not be created in all suitable years or may be created following periods of less than or more than 60 days of nonstorage during the growing season.)
- Water would be available to DW every year to flood shallow-water wetlands.

Definitions of Habitat Condition Classes

Definitions of habitat condition classes are applicable only to the analysis of project impacts on vegetation and wildlife resources on reservoir islands.

Full Storage. Full storage under Alternatives 1 and 2 is defined as water storage that exceeds 64 thousand acre-feet (TAF) on Bacon Island and 60 TAF on Webb Tract. At a storage volume of 128 TAF or greater, the islands would be completely inundated, except the riprapped portions of the levee slopes.

Full storage under Alternative 3 (four reservoir islands) is defined for Bacon Island and Webb Tract as described for Alternatives 1 and 2 and for Bouldin Island and Holland Tract as water storage that exceeds 52 TAF and 28 TAF, respectively. Full storage would be achieved on all islands when 256 TAF of water has been diverted onto the islands.

Partial Storage. Partial storage under Alternatives 1 and 2 is defined as storage of 8-63 TAF on Bacon Island and 8-59 TAF on Webb Tract. Under Alternative 3, partial storage is defined for Bacon Island and Webb Tract as described for Alternatives 1 and 2 and for Bouldin Island and Holland Tract as storage of 8-51 TAF and 8-27 TAF, respectively.

Shallow Storage. Shallow storage under Alternatives 1 and 2 is defined as storage of 1-7 TAF on Bacon Island and Webb Tract. Under Alternative 3, shallow storage is defined as storage of 1-7 TAF on Bacon Island, Webb Tract, Bouldin Island, and Holland Tract.

Nonstorage. Nonstorage is defined as the condition when no water is stored or used to flood shallow-water wetlands.

Shallow-Water Wetland. Shallow-water wetland conditions would occur when approximately 1-7 TAF of water is diverted onto reservoir islands to flood vegetation to attract waterfowl and other wildlife associated with wetlands. Inner levee systems would be constructed on the island bottoms to circulate water through wetland management cells. The inner levee system and associated water control structures would be designed to allow at least 65% of each reservoir island to be flooded to create shallow-water wetlands. At least 50% of the flooded area would be managed to provide an average water depth of 12 inches. Shallow-water wetlands would be flooded only in years when there has been no storage for 60 or more consecutive days immediately before any day between September 15 and November 30. If DW does not flood to create shallow-water wetlands during suitable periods, reservoir islands would remain in a nonstorage condition.

No-Project Alternative

Predictions of island conditions under the No-Project Alternative are based on the report of a feasibility study prepared for DW by The McCarty Company, Diversified Agricultural Services (McCarty pers. comm.). This report outlines island-by-island recommendations for intensifying the production and yield of various crops. Crop diversification and a greater emphasis on perennial crops are general recommendations for all islands.

VEGETATION CONDITIONS UNDER ALTERNATIVE 1

Tables G2-1 and G2-2 present the frequency with which full-storage, partial-storage, shallow-storage, nonstorage, and shallow-water wetland conditions could be expected to occur during each month on Bacon Island and Webb Tract, respectively. The frequency and magnitude of the use of reservoir islands for water transfers or banking cannot be predicted. However, if reservoir islands are used for these purposes, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

Full Storage

Conditions on the reservoir islands during full-storage periods would range from riprapped levee slopes at elevations higher than the reservoir surfaces to water depths in excess of 25 feet. Exposed portions of riprapped levee slopes would remain largely unvegetated. Little or no aquatic vegetation would be expected to grow in the reservoirs because of constant water circulation and changing pool elevations associated with diversions and releases. Algae may become established on riprap along reservoir edges and in reservoirs during full-storage events that occur from late spring through September.

Partial Storage

Reservoir island habitat conditions will vary more under partial-storage conditions than under other storage conditions because of the greater range of areas of exposed island bottoms (i.e., terrestrial habitats), reservoir sizes, and water depths that can occur during partial-storage periods. Partial-storage reservoir conditions would range from saturated soils adjacent to reservoir shorelines to reservoir water depths in excess of 10 feet. At elevations higher than the reservoir surfaces, conditions would include exposed island bottoms and levee slopes (with or without riprap, depending on the type of levee design selected). Algae would be expected to become established under partial-storage conditions, as described for full storage.

Shallow portions of reservoirs under partial-storage conditions (i.e., water depths typically of 3 feet or less) provide water depths used by waterfowl and other aquatic wildlife; however, partial-storage periods that follow drawdown from full storage would provide little or no forage for wildlife because island bottoms would be unvegetated. Flooding of wetland vegetation for partial storage would provide wetland forage values in shallow portions of reservoirs.

Vegetation conditions in exposed portions of island bottoms would be the same as described below for shallow-water wetland periods if partial storage occurs during the growing season.

Shallow-Water Storage

Shallow-water storage occurs when stored water volumes are equal to water volumes used to create shallow-water wetlands. Vegetation conditions under shallow-water storage would be similar to those described for partial storage except that the areas of exposed island bottoms would be greater. Shallow storage that occurs following periods of nonstorage during the growing season would create vegetation conditions similar to those that would be created during shallow-water wetland periods. Habitat quality for wildlife, however, is expected to be lower because water depths would be uncontrolled (i.e., inner levee systems to circulate water would not be constructed) and the islands would not be seeded.

Nonstorage

Island bottoms during periods of nonstorage that immediately follow full-storage periods from November through March would consist of bare ground with little or no vegetation growth. During periods of nonstorage from April through October, plants would be expected to germinate within the first 30 days of nonstorage, although bare ground would be the predominant condition. Vegetation would grow rapidly, particularly during late spring and summer, following germination. Vegetation types and density would be similar to those described below for shallow-water wetlands.

As a result of seepage, permanent open-water habitat would be created in reservoir island borrow areas and in the drainage circulation network with implementation of Alternative 1. Water depths would range from 2 feet to 4 feet, but these areas probably would not support emergent vegetation because of previous storage events.

Shallow-Water Wetlands

Shallow-water wetlands could be created following extended periods (i.e., at least 60 consecutive days) of nonstorage during the growing season and would be managed until the first storage period, or through April if no storage occurs. Shallow-water wetland conditions could be expected to occur from September through April in approximately 9% of operating years (Tables G2-1 and G2-2). Wetlands on Bacon Island and Webb Tract would be flooded with up to 7 TAF of water between September and November (flooding dates would vary with vegetation maturity) to create shallow-water wetlands. DW would construct an inner levee system that would maintain a mean water depth of 1 foot and allow water to circulate through wetland cells.

Grasses, forbs, and emergents are expected to be the dominant plant species. The rate at which herbaceous vegetation would become reestablished on islands following complete or partial drawdowns of storage pools during the growing season is unknown. The density of vegetation would be sparse because seed sources for future plant crops are expected to be depleted during storage periods as a result of diminished seed viability with extended periods of inundation, export of seeds from islands during releases, and reduced seed crops produced on the islands. The primary sources of seeds and other propagules available to naturally revegetate the islands would be wind-borne plant material and material captured from the Delta during diversions rather than material produced on the islands.

At DW's discretion, reservoir islands may be seeded during nonstorage periods with watergrass, smartweed, and other important waterfowl forage plant species. If the reservoir islands are seeded, vegetation in wetlands and exposed areas would be much denser than it would be without seeding. Eventually, however, open-water conditions would be created as plants fall over as a result of wave action and waterfowl foraging.

Exterior Perimeter Levee Slopes and Levee Roads

Exterior levee slopes and roads would occupy approximately 152 acres. Recently maintained exterior riprapped slope banks generally would remain unvegetated. Vegetation on undisturbed riprapped slopes would include annual herbaceous species, such as wild oats, ripgut brome, rabbitsfoot grass, milk thistle, and wild radish; perennial species, such as reed canary grass, Bermuda grass, and common reed; and woody species, such as sandbar willow and buttonbush.

Generally, the 16-foot-wide levee roads would not support vegetation, except for Bermuda grass, suaeda, star-thistle, and peppergrass growing in the center line. Little vegetation would survive the periodic disturbance and grading for road maintenance and levee crown repair, but the general profile of the crest zone would not change.

Interior Levee Slopes

DW proposes to increase levee height and reinforce inner levee slopes using one of two methods (see Chapter 3D, "Flood Control"). Both methods would overbuild levees to allow for long-term settlement. The first method consists of constructing a 40-foot-wide 3:1 riprapped slope above a 10:1 earthen toe berm. The second method consists of constructing a 5:1 riprapped slope along the entire inner levee slope. Depending on the method used, between 133 acres and 380 acres would be riprapped, and levee slopes would occupy between 380 acres (3.5%) and 446 acres (4.1%) on the islands.

Little or no vegetation would be expected to become established along riprapped portions of the levees that would be inundated during storage periods. The upper 4 feet of the inner levee would never be inundated; therefore, vegetation similar to that described for the exterior levee slopes may eventually become established. Vegetation similar to that described for shallow-water wetlands would be expected to become established on the 10:1 toe berm during nonstorage periods.

Long-Term Soil Productivity

Environmental factors affecting soil conditions would be different under project operation than under the present agricultural management regime. Three potential differences would be the pronounced cycle of deep water storage, the possible yearly accumulation of fine silt during the storage period, and the annual accumulation of vegetation biomass in the absence of agricultural harvest. In general, implementing the project could slow the rate of land subsidence and reduce the loss of soil productivity caused by oxidation and wind erosion on Delta islands (see Chapters 3D, "Flood Control", and 3I, "Land Use and Agriculture").

During water storage periods, island bottom soils inundated at depths greater than those subject to wind mixing of the water column, perhaps over 10 feet, may be subject to periods of anaerobic conditions. Because topography of the island bottoms varies, predicting the frequency of water storage depths is difficult; however, this condition can be assumed to occur most often in borrow pits and other low areas during water storage operations. Portions of island bottoms inundated at depths of less than about 10 feet are not expected to be depleted of oxygen because wind would mix oxygenated water into the water column. Adequate oxygen also would be available to support organic decomposition following drawdowns between April and December. Monitoring of the simulated reservoir conditions at the Holland Tract demonstration wetland (Chapter 3G, "Vegetation and Wetlands") in April-July 1990 indicated well-oxygenated conditions and normal pH levels at a pool depth of 4 feet. Adverse effects of deep water storage on soil productivity and plant growth during the drawdown season are not expected.

Under present conditions, agricultural cultivation of Delta islands causes oxidation and deflation of their peat soils (California Department of Water Resources [DWR] 1988, 1989) (see Chapter 3D, "Flood Control"). The absence of such cultivation throughout the year would remove this cause of diminishing soil productivity and land subsidence under existing conditions.

Chapter 3C, "Water Quality", discusses concentrations of suspended sediments in water stored on the project islands in winter. As a worst-case scenario, net annual accumulation of surface siltation on the reservoir bottoms is estimated to be approximately 3.3 tons per acre, or less than 0.02 inch in thickness per year. The limited amount of predicted siltation over the predominantly peat soils is not likely to limit germination of seeds during nonstorage periods. Any annual accumulation of silt would tend to be incorporated into the soil profile by seasonal growth of vegetation, decomposition of subsequent plant biomass on top of the sediment, soil mixing by invertebrates and wind erosion, and movement of soils for inner levee system maintenances.

Chapter 3C, "Water Quality", also discusses dissolved minerals, nutrient and organic constituents, and contaminants (i.e., pesticides, herbicides, and trace metals) in water stored on the DW project islands. Based on a comparison of likely soil processes under water storage conditions and agricultural practices, it is predicted that implementation of Alternative 1 would not substantially change soil fertility and productivity potential on the DW project islands from current agricultural conditions.

VEGETATION CONDITIONS UNDER ALTERNATIVE 2

Tables G2-3 and G2-4 present the frequency with which full-storage, partial-storage, shallow-storage, nonstorage, and shallow-water wetland conditions could be expected to occur during each month on Bacon Island and Webb Tract, respectively. Conditions on the reservoir islands during these periods would be the same as those described for Alternative 1, except that because discharges would not be limited by percent-of-inflow Delta export limits specified in the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (WQCP) (see Chapter 2, "Delta Wetlands Project Alternatives"), the frequency with which each condition occurs differs from the frequency under Alternative 1, primarily from January through August. During this period, full storage occurs less frequently and partial-, shallow-, and nonstorage conditions occur more frequently. Except in October, the frequency with which shallow-water wetlands could be created is the same as under Alternative 1.

VEGETATION CONDITIONS UNDER ALTERNATIVE 3

Under this alternative, all four islands would be used for water storage. The portion of Bouldin Island north of State Route 12, however, would be managed as a wildlife habitat area (North Bouldin Habitat Area [NBHA]) and would not be used for water storage.

Tables G2-5 through G2-8 present the frequency with which full-storage, partial-storage, shallow-storage, nonstorage, and shallow-water wetland conditions could be expected to occur during each month on the reservoir islands. A total of 875 acres of habitat types would be created in the NBHA as follows:

- corn = 170 acres,
- perennial pond = 50 acres,
- riparian woodland = 200 acres,
- seasonal wetland = 313 acres,
- ditch = 17 acres,
- annual grassland = 29 acres, and
- fallow levee slope = 96 acres.

Conditions on islands during full-storage, partial-storage, shallow-storage, nonstorage, and shallow-water wetland periods would be the same as those described for Alternative 1.

Cumulative Conditions for Alternatives 1, 2, and 3

In future years, the permitted pumping rate of the State Water Project (SWP) Banks Pumping Plant could be increased to equal the full physical export pumping capacity. Tables G2-1 through G2-8 present the frequencies with which each storage condition class would be expected for these cumulative conditions under Alternatives 1, 2, and 3.

Vegetation conditions for each storage condition would be as described for Alternatives 1, 2, and 3. The frequency of nonstorage and shallow-water wetland periods under cumulative conditions, however, would increase substantially and the frequency of full-storage periods would decline from conditions that would occur under Alternatives 1, 2, and 3.

NO-PROJECT ALTERNATIVE

Tables G2-9 and G2-10 compare existing vegetation and agriculture-type acreage to estimated acreages under the No-Project Alternative. The predicted changes in land use are based on the following assumptions:

- Riparian (types R1 and R2) and freshwater marsh (M1) habitat would be reduced by cultivation and ditch clearing, except in the wetland complexes surrounding the blowout ponds on Holland and Webb Tracts and in several low-elevation tailwater wetlands for which cultivation would be impractical.

- Most land currently identified as fallow agriculture (A5) or supporting exotic marsh weeds (M3), typically in abandoned fields, would be reconverted to annual or perennial crops.

- Acreage of ditches and sloughs (O1) would remain as is, whereas a small decrease is expected in permanent open water (O2) because of water table lowering associated with improved field drainage.

- Most of the herbaceous upland habitat (H1 and H2), excluding the interior faces of levee slopes, would be converted to crops and orchards or vineyards that require well-drained soils.

- Areas of disturbed soils (D2) not presently used for agriculture, such as the pulp byproduct operation on Holland Tract, would be converted to crop or grazing use.

In general, agricultural land use would increase an estimated 20% (by about 3,000 acres) at the expense of other existing land uses and vegetation types (Table G2-10). Riparian woodland would decrease by 50%, and freshwater marsh would decrease by more than 80%.

Bacon Island

Under the No-Project Alternative, changes in maintenance or cropping patterns would be small relative to the existing diverse and well-managed agricultural programs. Cereal crops and orchards and vineyards would expand somewhat at the expense of herbaceous upland and fallow acreage.

Webb Tract

In December 1987, agriculture on Webb Tract was marginal because it never recovered from the 1980 levee failure and flood. Redevelopment of the infrastructure would require weed eradication, ditch clearing, and removal of riparian and wetland habitat from ditches and low-lying fields. Riparian forest and freshwater marsh would be removed, except for portions around the blowout ponds, and replaced with grain and corn crops. Open water acreage would probably be reduced somewhat because of improved drainage and reclamation for agriculture.

On Webb Tract, areas under agricultural land use would increase by approximately 50% (1,567 acres) at the expense of fallow land, herbaceous upland, exotic marsh, and riparian and freshwater marsh habitat. Riparian and freshwater marsh vegetation would experience a 25% reduction, a loss of about 200 acres.

Bouldin Island

An increase in ditch maintenance and weed eradication would result in a 31-acre decrease in marsh and riparian habitat. Some corn, wheat, or sunflower fields would be replaced by perennial plantings, including asparagus and vineyards. Otherwise, the dominant agriculture types would remain as winter wheat and summer corn, with sunflower and safflower as rotation crops for soil management purposes.

Holland Tract

In December 1987, Holland Tract was in a substandard agricultural condition. The island infrastructure was deteriorated and required a major redevelopment effort, including extensive clearing of riparian and marsh vegetation in canals, ditches, and low fields near the blowout ponds.

Under the No-Project Alternative, fallow sandy soils on the interior hills would be converted to grazing pasture, with pasture improvements, including disking, seeding, and water development. Other sandy loam sites would be converted to row and vegetable crops, further reducing herbaceous upland and exotic marsh vegetation while increasing grain crops and perennial crops. On high ground in the north-central part of Holland Tract, wheat, corn, and fallow land would be converted to orchards and vineyards. Existing lowland cornfields and wheat fields would be improved, causing a major reduction in poorly drained weedy areas.

Riparian and marsh habitat could be reduced by about 100 acres along drainage ditches and at levee seeps; riparian and marsh vegetation around the blowout pond would be retained. This would represent an overall 33% decrease in wetland habitat on Holland Tract.

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Table G2-1. Frequency of Habitat Condition Classes on Bacon Island under Alternative 1 and Cumulative Conditions for Alternative 1 (Percentage of Years)

	Alternative 1					Cumulative Alternative 1				
Month	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	65.7	13.0	0.0	21.4	0.0	58.6	4.3	0.0	32.9	0.0
June	61.4	15.9	1.4	21.4	0.0	52.9	14.3	0.0	32.9	0.0
July	34.3	21.4	10.0	34.3	0.0	1.4	1.4	0.0	97.1	0.0
August	10.0	5.7	4.3	80.0	0.0	1.4	0.0	0.0	98.6	0.0
September	11.4	1.4	1.4	57.1	28.6	4.3	1.4	2.9	0.0	91.4
October	28.6	2.9	0.0	20.0	48.6	14.3	5.7	0.0	1.4	78.6
November	45.7	1.4	1.4	1.4	50.0	30.0	5.7	0.0	2.9	61.4
December	51.4	7.1	2.9	2.9	35.7	40.0	5.7	0.0	7.1	47.1
January	67.1	5.7	1.4	4.3	21.4	57.1	5.7	0.0	2.9	34.3
February	74.3	5.7	4.3	1.4	14.3	64.3	8.6	2.9	1.4	22.9
March	75.7	7.1	4.3	4.3	8.6	67.1	8.6	2.9	1.4	20.0
April	74.3	2.9	5.7	8.6	8.6	65.7	4.3	7.1	2.9	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

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Table G2-2. Frequency of Habitat Condition Classes on Webb Tract under Alternative 1 and Cumulative Conditions for Alternative 1 (Percentage of Years)

	Alternative 1					Cumulative Alternative 1				
Month	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	67.1	11.6	0.0	21.4	0.0	58.6	8.6	0.0	32.9	0.0
June	62.9	14.5	1.4	21.4	0.0	55.7	11.4	0.0	32.9	0.0
July	37.1	18.6	10.0	34.3	0.0	1.4	1.4	0.0	97.1	0.0
August	10.0	7.1	7.1	75.7	0.0	1.4	0.0	0.0	98.6	0.0
September	11.4	1.4	1.4	57.1	28.6	4.3	1.4	2.9	0.0	91.4
October	28.6	2.9	0.0	20.0	48.6	14.3	5.7	0.0	1.4	78.6
November	45.7	1.4	1.4	1.4	50.0	31.4	4.3	0.0	2.9	61.4
December	51.4	7.1	2.9	2.9	35.7	40.0	5.7	0.0	7.1	47.1
January	68.6	4.3	1.4	4.3	21.4	57.1	5.7	0.0	2.9	34.3
February	75.7	4.3	4.3	1.4	14.3	64.3	8.6	2.9	1.4	22.9
March	75.7	7.1	4.3	4.3	8.6	67.1	8.6	2.9	1.4	20.0
April	74.3	5.7	5.7	8.6	8.6	65.7	4.3	5.7	4.3	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

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Table G2-3. Frequency of Habitat Condition Classes on Bacon Island under Alternative 2 and Cumulative Conditions for Alternative 2 (Percentage of Years)

	Alternative 2					Cumulative Alternative 2				
Month	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	50.0	10.0	2.9	37.1	0.0	41.4	11.4	0.0	51.4	0.0
June	27.1	10.0	1.4	61.4	0.0	14.3	7.1	0.0	78.6	0.0
July	12.9	10.0	37.1	40.0	0.0	1.4	1.4	0.0	97.1	0.0
August	4.3	1.4	10.0	84.3	0.0	1.4	0.0	0.0	98.6	0.0
September	11.4	1.4	1.4	57.1	28.6	4.3	1.4	2.9	0.0	91.4
October	28.6	2.9	0.0	14.2	54.3	14.3	5.7	0.0	1.4	78.6
November	45.7	1.4	1.4	1.4	50.0	24.3	10.0	1.4	2.9	61.4
December	51.4	7.1	2.9	2.9	35.7	35.7	4.3	0.0	14.3	45.7
January	67.1	7.1	1.4	2.9	21.4	51.4	5.7	1.4	7.1	34.3
February	62.9	7.1	8.6	7.1	14.3	35.7	8.6	8.6	10.0	22.9
March	55.7	4.3	5.7	25.7	8.6	41.4	8.6	0.0	30.0	20.0
April	55.7	5.7	2.9	27.1	8.6	41.4	22.9	2.9	27.1	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

Table G2-4. Frequency of Habitat Condition Classes on Webb Tract under Alternative 2 and Cumulative Conditions for Alternative 2 (Percentage of Years)

	Alternative 2					Cumulative Alternative 2				
Month	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	50.0	10.0	2.9	37.1	0.0	41.4	7.1	0.0	51.4	0.0
June	27.1	10.0	1.4	61.4	0.0	18.6	2.9	0.0	78.6	0.0
July	12.9	10.0	37.1	40.0	0.0	1.4	1.4	0.0	97.1	0.0
August	4.3	1.4	10.0	84.3	0.0	1.4	0.0	0.0	98.6	0.0
September	11.4	1.4	1.4	57.1	28.6	4.3	1.4	2.9	0.0	91.4
October	28.6	2.9	0.0	14.2	54.3	14.3	5.7	0.0	1.4	78.6
November	45.7	1.4	1.4	1.4	50.0	25.7	8.6	1.4	2.9	61.4
December	51.4	7.1	2.9	2.9	35.7	35.7	4.3	0.0	14.3	45.7
January	68.6	5.7	2.9	2.9	21.4	51.4	5.7	1.4	7.1	34.3
February	62.9	7.1	8.6	7.1	14.3	50.0	8.6	8.6	10.0	22.9
March	55.7	4.3	5.7	25.7	8.6	42.9	7.1	0.0	30.0	20.0
April	55.7	5.7	2.9	27.1	8.6	42.9	7.1	2.9	27.1	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

C-062133

Table G2-5. Frequency of Habitat Condition Classes on Bacon Island under Alternative 3 and Cumulative Conditions for Alternative 3 (Percentage of Years)

Month	Alternative 3					Cumulative Alternative 3				
	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	51.4	12.9	2.9	32.9	0.0	37.1	13.0	0.0	50.0	0.0
June	27.1	24.3	0.0	48.6	0.0	17.1	8.7	7.1	67.1	0.0
July	11.4	30.0	28.6	30.0	0.0	2.9	5.7	4.3	87.1	0.0
August	2.9	11.4	8.6	77.1	0.0	1.4	0.0	0.0	98.6	0.0
September	7.1	7.1	2.9	52.9	30.0	1.4	4.3	2.9	7.1	84.3
October	20.0	11.4	0.0	17.1	51.4	5.7	14.3	0.0	1.4	78.6
November	37.1	10.0	1.4	1.4	50.0	18.6	15.7	1.4	2.9	61.4
December	50.0	8.6	4.3	1.4	35.7	31.4	10.0	0.0	12.9	45.7
January	61.4	14.3	1.4	1.4	21.4	51.4	5.7	2.9	7.1	32.9
February	62.9	15.7	1.4	5.7	14.3	47.1	17.1	1.4	11.4	22.9
March	54.3	11.4	4.3	21.4	8.6	40.0	11.4	1.4	27.1	20.0
April	54.3	11.4	1.4	24.3	8.6	41.4	8.6	2.9	27.1	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

C-062135

Table G2-6. Frequency of Habitat Condition Classes on Webb Tract under Alternative 3 and Cumulative Conditions for Alternative 3 (Percentage of Years)

	Alternative 3					Cumulative Alternative 3				
Month	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	51.4	12.9	2.9	32.9	0.0	38.6	11.6	0.0	50.0	0.0
June	27.1	24.3	0.0	48.6	0.0	17.1	8.7	7.1	67.1	0.0
July	11.4	30.0	28.6	30.0	0.0	2.9	5.7	4.3	87.1	0.0
August	2.9	11.4	8.6	77.1	0.0	1.4	0.0	0.0	98.6	0.0
September	7.1	7.1	2.9	52.9	30.0	1.4	4.3	2.9	7.1	84.3
October	20.0	11.4	0.0	17.1	51.4	5.7	14.3	0.0	1.4	78.6
November	38.6	8.6	1.4	1.4	50.0	18.6	15.7	1.4	2.9	61.4
December	51.4	7.1	4.3	1.4	35.7	32.9	8.6	0.0	12.9	45.7
January	61.4	14.3	1.4	1.4	21.4	52.9	4.3	2.9	7.1	32.9
February	62.9	15.7	1.4	5.7	14.3	47.1	17.1	1.4	11.4	22.9
March	54.3	11.4	4.3	21.4	8.6	41.4	10.0	1.4	27.1	20.0
April	54.3	11.4	1.4	24.3	8.6	42.9	7.1	2.9	27.1	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

C-062135

Table G2-7. Frequency of Habitat Condition Classes on Bouldin Island under Alternative 3 and Cumulative Conditions for Alternative 3 (Percentage of Years)

	Alternative 3					Cumulative Alternative 3				
Month	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	54.3	10.1	2.9	32.9	0.0	40.0	10.0	0.0	50.0	0.0
June	31.4	20.3	0.0	48.6	0.0	18.6	7.1	7.1	67.1	0.0
July	18.6	37.1	28.6	30.0	0.0	2.9	5.7	4.3	87.1	0.0
August	2.9	11.4	8.6	77.1	0.0	1.4	0.0	0.0	98.6	0.0
September	8.6	5.7	2.9	52.9	30.0	2.9	2.9	2.9	7.1	84.3
October	20.0	11.4	0.0	17.1	51.4	7.1	12.9	0.0	1.4	78.6
November	40.0	7.1	1.4	1.4	50.0	18.6	15.7	1.4	2.9	61.4
December	52.9	5.7	4.3	1.4	35.7	32.9	8.6	0.0	12.9	45.7
January	62.9	12.9	1.4	1.4	21.4	55.7	1.4	2.9	7.1	32.9
February	62.9	15.7	1.4	5.7	14.3	50.0	14.3	1.4	11.4	22.9
March	57.1	8.6	4.3	21.4	8.6	42.9	8.6	1.4	27.1	20.0
April	55.7	10.0	1.4	24.3	8.6	44.3	5.7	2.9	27.1	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

Table G2-8. Frequency of Habitat Condition Classes on Holland Tract under Alternative 3 and Cumulative Conditions for Alternative 3 (Percentage of Years)

Month	Alternative 3					Cumulative Alternative 3				
	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland	Full Storage	Partial Storage	Shallow Storage	Nonstorage	Shallow-Water Wetland
May	58.6	5.8	2.9	32.9	0.0	47.1	2.9	0.0	50.0	0.0
June	37.1	14.5	0.0	48.6	0.0	21.4	4.3	7.1	67.1	0.0
July	24.3	17.1	28.6	30.0	0.0	4.3	4.3	4.3	87.1	0.0
August	5.7	8.6	8.6	77.1	0.0	1.4	0.0	0.0	98.6	0.0
September	11.4	2.9	2.9	52.9	30.0	4.3	1.4	2.9	7.1	84.3
October	28.6	2.9	0.0	17.1	51.4	15.7	4.3	0.0	1.4	78.6
November	45.7	1.4	1.4	1.4	50.0	25.7	8.6	1.4	2.9	61.4
December	54.3	4.3	4.3	1.4	35.7	37.1	4.3	0.0	12.9	45.7
January	70.0	5.7	1.4	1.4	21.4	55.7	1.4	2.9	7.1	32.9
February	68.6	10.0	1.4	5.7	14.3	54.3	10.0	1.4	11.4	22.9
March	61.4	4.3	4.3	21.4	8.6	48.6	2.9	1.4	27.1	20.0
April	62.9	2.9	1.4	24.3	8.6	47.1	2.9	2.9	27.1	20.0

Notes: Percentages may not total to 100.0 because of rounding.

Frequencies were estimated based on the 70-year hydrologic record for the Delta. The frequency with which each flood condition class would occur in future years, however, is unpredictable. Frequencies do not include periods when reservoir islands may be used for water transfers or banking. If reservoir islands are used to transfer or bank water, the frequency of storage periods could be expected to increase and the frequency of nonstorage and shallow-water wetland periods could be expected to decrease.

Table G2-9. Habitat-Type Classification for the DW Project Islands

Habitat Group	Code	Description	Comments	Dominant or Typical Plant Species
Riparian	R1	Cottonwood-willow woodland	Cottonwood and willow trees	Fremont cottonwood, red willow, yellow willow
	R2	Great Valley willow scrub	Willow shrubs and trees	Red willow, yellow willow, sandbar willow, Goodding's willow
Marsh	M1	Freshwater marsh	Inside islands	Cattail, bulrush, yellow nutsedge, pondweed, buttonbush
	M2	Tidal marsh	Outside main islands	Common tule, common reed, Olney's bulrush, California bulrush, common rush
	M3	Exotic marsh[a]	Dense upland and wetland weeds (sometimes dry in summer)	Annual smartweed, peppergrass, amaranth, wild radish, nettles, cocklebur, watergrass
Woody, non-native	W1	Mature trees	Shade trees and windbreaks	Eucalyptus, pine, elm
	W2	Mixed ornamental	Shrubs and lawn	Turf grasses, miscellaneous ornamental shrubs
Herbaceous upland	H1	Annual grassland	True uplands and sand hills	Wild oats, barley, rip-gut brome, Italian rye-grass
	H2	Exotic perennial grassland[a]	Mixed weeds in fields and on levee slopes	Bermuda grass, perennial ryegrass, Johnson grass
Agriculture	A1	Grain and seed crops		Corn, wheat, sunflowers, potatoes
	A2	Perennial crops		Asparagus, vineyards
	A3	Pasture	Permanently grazed	Tall fescue, orchard grass, canary grass, ryegrass, legumes
	A4	Waterfowl food crops	Managed wetlands	Smartweed, watergrass, bulrush
	A5	Fallow	Short-term fallow fields	Yellow star-thistle, Russian thistle, houseweed, lamb's quarter, telegraph weed
Open water	O1	Canals and ditches	Permanent water	Dallis grass, knot grass, Himalaya berry, smartweed
	O2	Permanent ponds	Still water	Water hyacinth, water primrose, azolla
	O3	Mudflats	Tidal, open bare mud	None
Developed	D1	Structures	Buildings and marinas	
	D2	Paving and exposed earth	Roads, landfills, and unvegetated exposed areas	Largely unvegetated

[a] Exotic habitats are dominated by weedy plant species that are not native to the Delta.

Source: JSA 1988.

Table G2-10. Predicted Changes in Acreages of Habitat Types under the No-Project Alternative

Habitat Type	Bacon Island		Webb Tract		Bouldin Island		Holland Tract		Total		
	1987 Acreage	No-Project Acreage	1987 Acreage	No-Project Acreage	1987 Acreage	No-Project Acreage	1987 Acreage	No-Project Acreage	1987 Acreage	No-Project Acreage	No-Project Acreage as Percentage of 1987 Acreage
Riparian woodland and scrub (R1, R2)	3	3	106	56	17	7	122	46	248	112	45
Freshwater marsh (M1)	3	0	172	16	21	0	28	2	224	18	8
Exotic marsh and demonstration pond (M3, A4)	30	0	783	40	115	0	323	0	1,251	40	3
Woody non-native and herbaceous upland (W1, W2, H1, H2)	528	261	839	220	354	349	569	113	2,290	943	41
Subtotal	564	264	1,900	332	507	356	1,042	161	4,013	1,113	28
Annual grain crops (A1)	3,091	3,126	2,695	4,961	4,530	3,329	1,118	3,083	11,434	14,499	127
Perennial crops orchards/vineyards (A2)	1,348	1,969	0	0	0	2,097	423	610	1,771	4,676	264
Pasture/hog farm (A3)	0	0	61	0	34	0	571	256	666	256	38
Fallow (A5)	355	0	638	0	712	0	785	0	2,490	0	0
Subtotal	4,794	5,095	3,394	4,961	5,276	5,426	2,897	3,949	16,361	19,431	119
Sloughs and ditches (O1)	92	92	50	50	118	118	45	45	305	305	100
Other open water (O2, O3)	3	3	106	106	9	9	23	23	141	141	100
Developed (D1, D2)	86	86	20	20	75	75	243	71	424	252	59
Subtotal	181	181	176	176	202	202	311	139	870	698	80
Total	5,539	5,540	5,470	5,469	5,985	5,984	4,250	4,249	21,244	21,242	100

Note: Minor inconsistencies in totals are the result of rounding.